ORIGINAL ARTICLE

Predictors for falls among hospital inpatients with impaired mobility

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SUMMARY

Gait and balance disturbances have been shown to predispose to falls in hospital. We aimed to investigate the patient characteristics associated with an unsafe gait and to determine what features predispose to falling in this group of hospital inpatients. In a prospective open observational study we studied 825 patients admitted for rehabilitation following acute medical illness or a surgical procedure. The patient's gait was assessed with the 'get up and go' test and classified into one of four categories—normal; abnormal but safe with or without mobility aids; unsafe; or unable.

72.6% of patients were assessed as having an unsafe gait. The factors independently associated with an unsafe gait were confusion, abnormal lower limbs, hearing defects and the use of tranquillizers. Patients with an unsafe gait who fell were more likely than the non-fallers within the group to have had falls in the past (85.3% versus 73.8%) and to be confused (66.2% versus 34.1%). Patients with both these characteristics had a 37.5% chance of falling compared with 15.4% in patients with one and 11.2% in patients with none of these characteristics.

The presence of confusion and a history of falls identifies those patients who are at greatest risk of falls. Such patients might be the focus of special efforts at falls prevention.

INTRODUCTION

Falls are a major cause of disability and mortality in elderly people over 75 years in the UK. Each year over 400 000 older people in England attend accident and emergency departments with an osteoporotic hip fracture, the outcome being fatal in 14 000.[1] Gait and balance disturbances have been shown to predispose to falls both outside[2] and inside hospital,[3] and several tests that include gait and balance have been validated into tools that predict falls.[3–11] The components that contribute to an unsafe gait are not only musculoskeletal;[12] among them are defects of vision and hearing, for example.[2,13] An unanswered question is what makes some patients with an unsafe gait fall while others do not. Despite close examination of such indices as stride velocity, length and frequency, gait analysts have been unable to determine the level of derangement that is critical for falls.[14] A more practical approach, acknowledging the interaction of other characteristics, is to classify gait into one of four groups—normal; safe with or without using mobility aids; unsafe; unable.[15] We studied the patient

characteristics associated with these easily recognizable gait patterns. By comparing these characteristics in fallers and non-fallers we also attempted to determine why some patients with an unsafe gait fall and to devise a simple method of risk stratification.

METHODS

Approval was obtained from the local ethics committee. In a prospective open observational study over one year we studied 825 consecutive patients admitted to three rehabilitation wards in a community rehabilitation hospital. The hospital admitted patients for rehabilitation and continuing medical care after an acute medical illness or an orthopaedic operation.

All patients were assigned to one of the four categories by use of the 'get up and go' test.[16] The gait was recorded as unsafe if the patient showed unsteadiness or evidence of being at risk of falling during the test or any other time. If there was any doubt about the patient's performance, the gait was classed as unsafe.[17] Inter-rater reliability was checked beforehand in an observational study (Unpublished) and showed more than 90% agreement between the main observer and various physiotherapists. Other characteristics assessed on admission included falls in the past, medications (tranquillizers, diuretics and other antihypertensives,

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antiparkinsonism agents, antidepressants), visual impairment, hearing impairment, abnormal lower limbs (e.g. hemiplegia, neuropathy or any condition judged to interfere with mobility such as a deep vein thrombosis, cellulitis, foot abnormalities or severe arthritic changes) and acute or chronic confusion. A patient was deemed visually impaired if registered blind or having a visual acuity of 6/60 or less on a Snellen chart using glasses if appropriate. A hearing defect was defined as the inability to follow a conversation, with or without a hearing aid.[18] Patients were screened for cognitive impairment and confusion by use of the Abbreviated Mental Test score, and those scoring <7/10 were categorized as confused.[19]

The outcome measures recorded were the number of fallers, total falls, number of recurrent fallers and number of patients sustaining an injury during the inpatient period under study. Falls occurring before the acute admission phase were not included. An injury was recorded when it resulted in bruising, cuts or fractures. Secondary outcome measures were place of discharge and mortality. The hospital had a policy of recording all falls on a standard incident form, and all patients who had a fall had a medical assessment. Recording of falls was therefore considered complete.

Statistical analysis

The χ^2 test or Fisher's exact probability test as appropriate was used to evaluate categorical data including the number of fallers, recurrent fallers and injured patients. Student's t test was used for continuous data. The Mann–Whitney test was used to compare total numbers of falls. Patients with an unsafe gait were compared with patients with a safe gait (including the group with a normal gait and those mobilizing safely with walking aids). A forward conditional logistic regression analysis was performed to analyse the physical characteristics associated with an unsafe gait.

RESULTS

We studied 825 patients (294 M, 531 F) with a mean age of 81.9 years. 72.6% were identified as having an unsafe gait (women 66.8%, mean age 82.1 years), 19.8% were safe with either a normal gait (total 4.0%; women 42.4% mean age 79.6 years) or using mobility aids (total 15.8%; women 55.4% mean age 80.7 years) and 7.6% were unable to mobilize (women 73.0% mean age 83.5 years). The age variations between the groups were not statistically significant. Women were more likely to have an unsafe gait than men (66.7% versus 58.4%; P=0.03). Patients with an unsafe gait differed from the safe gait groups particularly with regard to history of falls, hearing defects, abnormal limbs and confusion and were also more likely to be on tranquillizers (Table 1). Logistic regression analysis of the

factors associated with an unsafe gait showed that confusion (P=0.01), abnormal limbs (P<0.0001), tranquillizer use (P=0.009) and hearing defects (P=0.02) were independently associated with an abnormal gait.

Patients with unsafe gaits were at excess risk of having a fall and of requiring a nursing home on discharge (Table 2). Their hospital stays were also longer than those of patients with a safe gait (27.1 versus 16.2 days; P=0.001). Mortality was higher in the unsafe-gait group than in those with a safe gait, but lower than in the patients unable to mobilize.

Since most of the falls occurred in the group with unsafe gait, we compared the patient characteristics in this group between fallers and non-fallers (Table 3). The fallers were more likely to be confused and to have had falls in the past. There was a trend to greater use of tranquillizers by the fallers. Patients with neither a previous history of falls nor confusion had an 11.2% risk of falling. Patients with one of these factors had a 15.4% risk while those with both of these risk factors had a 37.5% risk of falls.

DISCUSSION

This study had limitations. It was conducted in a rehabilitation environment and the results may not be generalizable to other ward environments. In addition some of the tests used (such as the 'get up and go' test and the assessment of hearing) are open to subjective interpretation. However, we made several important observations. Patients with an unsafe gait have a large number of comorbidities that contribute to their poor mobility. Confusion, tranquillizer use and hearing impairment are independently associated with an unsafe gait. An important aspect of patient rehabilitation and improving mobility might be the identification of these factors and attempts to correct them. Safe mobility requires an appreciation of one's limitations and of the environmental hazards. Confused patients often lack insight into these matters and tend not to take safety precautions. It is possible that tranquillizers emerged as a (marginal) risk factor because of their use in managing patients with confusion. In their own right, however, they promote drowsiness and muscle weakness and blunten the postural reflexes. Their use should therefore be critically reviewed in such patients. The reasons why hearing impairment predisposes to an unsafe gait in this environment are more difficult to understand. Perhaps it causes increased difficulty in receiving and implementing safety instructions such that the patient is perceived as being unable to mobilize safely. Alternatively, vestibular dysfunction could be a factor.

Why do some patients with an unsafe gait fall and others not? We found that the fallers group were more likely to be confused and to have a history of falls in the past. Patients

Table 1 **Patient characteristics associated with a safe or unsafe gait**

	Safe n=163 (%)	Unsafe n=599 (%)	P	Odds ratio	95% CI
Previous falls (%)	69 (42.3)	458 (76.5)	< 0.0001	4.43	3.02–6.36
Visual defect (%)	23 (14.1)	103 (17.2)	0.42	1.26	0.87–2.10
Hearing defect (%)	24 (14.7)	170 (28.3)	0.006	2.29	1.44–3.66
Limb (%)	52 (31.9)	429 (71.6)	< 0.0001	5.38	3.71–7.84
Confusion (%)	34 (20.8)	258 (43.1)	< 0.0001	4.43	3.07–6.36
Diuretics (%)	82 (50.3)	282 (47.1)	0.52	0.87	0.62–1.24
Antidepressants (%)	65 (39.8)	192 (32.1)	0.08	0.71	0.40–1.01
Antihypertensives (%)	12 (7.4)	76 (12.7)	0.08	1.82	0.96–3.45
Antiparkinsonian (%)	4 (2.5)	37 (6.2)	0.09	2.61	0.91–7.45
Tranquillizers (%)	25 (15.4)	143 (23.9)	0.02	1.73	1.08–2.75

CI=confidence interval

Table 2 **Outcome measures associated with safe and unsafe gait**

No. (%)	Safe n=163 (%)	Unsafe n=599 (%)	P	Odds ratio	95% CI
Non-fallers	152 (93.2)	463 (77.3)			
Fallers	11 (6.7)	136 (22.7)	< 0.0001	4.05	2.12–8.53
Single fallers	7 (4.3)	93 (15.5)	0.0003	4.09	1.86–9.01
Recurrent fallers	4 (2.4)	43 (7.2)	0.041	3.07	1.08–8.69
Injury sustained	4 (2.5)	51 (8.5)	0.013	3.69	1.32–14.3
Total falls	14	224	< 0.0001		
Discharge destination					
Home	134 (82.2)	329 (54.9)	< 0.0001	0.16	0.11–0.25
Residential home	6 (3.6)	33 (5.5)	0.46	1.52	0.62–3.71
Nursing home	8 (4.9)	113 (18.8)	< 0.0001	4.5	2.15–9.45
Other NHS	8 (4.9)	35 (5.9)	0.78	1.2	0.54–2.64
Mortality	7 (4.3)	89 (14.9)	0.0005	3.88	1.76–8.57

CI=confidence interval

Table 3 **Characteristics of fallers and non-fallers among patients with an unsafe gait**

	Non-fallers n=463 (%)	Fallers n=136 (%)	P	Odds ratio	95% CI
Previous falls (%)	342 (73.8)	116 (85.3)	0.008	2.05	1.22–3.44
Visual defect (%)	77 (16.6)	26 (19.1)	0.58	1.18	0.72–1.93
Hearing defect (%)	124 (26.8)	46 (33.8)	0.13	1.39	0.92–2.10
Limb (%)	330 (71.3)	99 (72.7)	0.48	1.07	0.70–1.65
Confusion (%)	158 (34.1)	90 (66.2)	< 0.0001	3.77	3.52–5.65
Diuretics (%)	223 (48.1)	60 (44.1)	0.46	0.85	0.57–1.24
Antidepressants (%)	57 (12.3)	20 (14.7)	0.55	1.22	0.70–2.12
Antihypertensives (%)	142 (30.7)	50 (36.7)	0.22	1.31	0.88–1.96
Antiparkinsonian (%)	25 (5.4)	12 (8.8)	0.21	1.69	0.82–3.47
Tranquillizers (%)	102 (22.0)	41 (30.1)	0.07	1.52	0.99–2.34

CI=confidence interval

showing both these factors were much more likely to fall than those with none or only one.

It is still unclear what measures if any can be taken to prevent patients with an unsafe gait from falling. The arguments in favour of multifactorial interventions remain weak.[17] However, the presence of confusion and a previous history of falls identifies those patients with an unsafe gait who are at most risk. These characteristics are easily identified in routine practice. Thus a simple risk stratification, in patients with 'unsafe' gait, should allow a targeted approach to prevention.

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